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Koji Yoshida et al.

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Filed: July 23, 2003 Art Unit: 2834

For: SMALL VIBRATION MOTOR AND METHOD OF MANUFACTURING THE SAME Examiner: D. D. Le

SUBMISSION OF CERTIFIED ENGLISH TRANSLATION OF THE PRIORITY DOCUMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicants hereby submit the certified English translation of the Priority Document:

Country	Application No.	Date
Japan	2002-220889	July 30, 2002

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 18-0013, under Order No. SON-2781 from which the undersigned is authorized to draw.

Dated: October 10, 2006

Respectfully submitted,

By_____
Ronald P. Kananen
Registration No.: 24,104
RADER, FISHMAN & GRAUER PLLC
Correspondence Customer Number: 23353
Attorney for Applicant

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IN THE UNITED STATES PATENT AND TRADE MARK OFFICE

APPLICANTS: Koji YOSHIDA et al.

APPLICATION NO.: 10/624,603
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GROUP ART UNIT: 2834
EXAMINER: Dang D. Le
TITLE: Small Vibration Motor and Method of Manufacturing the Same

Hon. Commissioner of Patents and Trademarks,
Washington, D.C. 20231

SIR;

CERTIFIED TRANSLATION

I, Hiroaki ISHIZAWA, am an official translator of the Japanese language into the English language and I hereby certify that the attached comprises an accurate translation into English of Japanese Application No. 2002-220889, filed on July 30, 2002.

I hereby declare that all statements made herein of my own knowledge are true and that all statement made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

October 2, 2006

Date

石沢宏明

Hiroaki ISHIZAWA

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[Inventor]

[Address or Domicile] c/o Sony Corporation
7-35 Kitashinagawa 6-chome,
Shinagawa-ku, Tokyo, Japan

[Name] Koji YOSHIDA

[Inventor]

[Address or Domicile] c/o Sony Corporation
7-35 Kitashinagawa 6-chome,
Shinagawa-ku, Tokyo, Japan

[Name] Shun KAYAMA

[Inventor]

[Address or Domicile] c/o Sony Corporation
7-35 Kitashinagawa 6-chome,
Shinagawa-ku, Tokyo, Japan

[Name] Katsuhiro YONEYAMA

[Inventor]

[Address or Domicile] c/o Sony Corporation
7-35 Kitashinagawa 6-chome,
Shinagawa-ku, Tokyo, Japan

[Name] Yukiko SHIMIZU

[Applicant for Patent]

[Identification No.] 000002185

[Name or Appellation] Sony Corporation

[Agent]

[Identification No.] 100096699

[Patent Attorney]

[Name or Appellation]	Hidemi KASHIMA	
[Designation of Charge]		
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[Name of Document] SPECIFICATION

[Title of the Invention] METHOD OF MANUFACTURING A VIBRATION GENERATING APPARATUS AND VIBRATION GENERATING APPARATUS

[Claims]

[Claim 1]

A method of manufacturing a vibration generating apparatus characterized by comprising:

a step of mounting a driving electronic part and a start torque generating coil on a board;

a step of placing a magnet so as to face on said start torque generating coil in a rotor yoke, in a rotor composed of said rotor yoke and a shaft;

a step of placing an unbalance weight at a part of said rotor yoke;

a step of fixing a bearing to a bottom plate;

a step of installing a bottom plate, on which said bearing is placed, to said board;

a step of engaging said shaft with said bearing and then installing said rotor; and

a step of covering said board, said driving electronic part and said rotor with a cover, and adhering said cover to said bottom plate and then packaging.

[Claim 2]

The method of manufacturing the vibration generating apparatus according to claim 1 characterized in that:

as said driving electronic part, at least an integrated circuit composed of non-molded bare chips is mounted on said board.

[Claim 3]

The method of manufacturing the vibration generating apparatus according to claim 1 characterized in that:

said board is formed with a flexible substrate, and said start

torque generating coil is electrically connected to said flexible substrate through three terminals.

[Claim 4]

The method of manufacturing the vibration generating apparatus according to claim 1 characterized in that:

the method includes a step of forming a terminal, which is engaged with a connector mounted on a mother board and thereby electrically connected, on a substrate protruded from said package.

[Claim 5]

The method of manufacturing the vibration generating apparatus according to claim 1 characterized in that:

the method includes a step of placing a terminal, which is engaged with a socket mounted on a mother board and thereby electrically connected, on said package.

[Claim 6]

The method of manufacturing the vibration generating apparatus according to claim 1 characterized in that:

the method includes a step of forming a land, which is electrically connected to a land formed on a mother board, on a surface in contact with said mother board of said package.

[Claim 7]

A vibration generating apparatus characterized by comprising:

a rotor yoke which is fixed to a shaft and in which an unbalance weight and a magnet are placed;

a start torque generating coil that is placed on a board so as to face on said magnet;

a driving electronic part placed on said board, which includes an integrated circuit composed of non-molded bare chips, supplies an alternating current to said start torque generating coil, and rotates said rotor yoke around said shaft;

a bottom plate which supports said board and to which a bearing

that said shaft is engaged with is fixed; and

a cover, which is adhered to said bottom plate, for covering said rotor yoke, said start torque generating coil and said driving electronic part.

[Claim 8]

The vibration generating apparatus according to claim 7 characterized in that:

said board is formed with a flexible substrate, and said start torque generating coil is electrically connected to said flexible substrate through three terminals.

[Claim 9]

The vibration generating apparatus according to claim 7 characterized by comprising:

a terminal that is formed on a substrate protruded from said package, and engaged with a connector mounted on a mother board, and thereby electrically connected.

[Claim 10]

The vibration generating apparatus according to claim 7 characterized by comprising:

a terminal that is placed in said cover or said bottom and engaged with a socket mounted on a mother board and thereby electrically connected.

[Claim 11]

The vibration generating apparatus according to claim 7 characterized by comprising:

a land which is formed on a surface in contact with a mother board, in said cover or said bottom, and electrically connected to a land formed on said mother board.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention pertains]

The present invention relates to a vibration generating apparatus, which is built in an electronic apparatus such as a portable telephone, PDA and the like, for generating a vibration, and a method of manufacturing the same.

[0002]

[Prior Art]

Conventionally, the electronic apparatus such as the portable telephone, the PDA and the like includes the mechanism of a so-called manner mode for propagating an incoming sound through a vibration, and an alarm for propagating an arrival at a predetermined time through a vibration, and the like. A vibration actuator as a mechanism for generating a vibration is built in such an electronic apparatus.

[0003]

Fig. 14A is a diagrammatic view showing the inner structure of a portable telephone in which a vibration motor serving as a conventional vibration actuator is built. Fig. 14B is a diagrammatic view showing the appearance of the vibration motor. As shown in Fig. 14A, printed circuit boards (mother boards) 101, 102 are mounted within the portable telephone 100. A speaker 103 and a vibration motor 104 are connected to the side of the printed circuit board 101. The vibration motor 104 is driven by a driver IC 105 mounted on the printed circuit board 101. On the other hand, a power supply IC 110, a converter IC, an MPU 112, a memory IC 113 and the like are mounted on the side of the printed circuit board 102.

[0004]

The illustrated vibration motor 104 is the motor with a brush. As shown in Fig. 14B, a weight 125 is fixed around an output shaft 120. When the vibration motor 104 is driven, the output shaft 120 is rotated,

and the weight 125 is eccentrically rotated. The eccentric rotation of the weight 125 causes a rotational unbalanced energy to be generated as a vibration component.

[0005]

[Problems to be solved by the Invention]

By the way, conventionally, when the motor with the brush is used as the vibration motor, the rotational defect caused by so-called slit-short can not be made zero. Thus, this raises a problem in a reliability of a vibration generation operation.

[0006]

Also, from the viewpoints of the volume of a portable apparatus and the like, the vibration motor is naturally desired to be smaller. A motor body can be reduced to, for example, a diameter of about 3.5 mm. However, if the diameter of the motor body is made smaller, the diameter of the weight for generating the rotational unbalanced energy is inappropriate, which decreases the vibration component. This results in a problem that the sufficient vibration can not be obtained. In particular, recently, the portable apparatus such as the portable telephone, the PDA and the like tends to be thinned. So, this has a problem that it is difficult to design the portable apparatus with a built-in cylindrical vibration motor.

[0007]

Also, from the viewpoints of the battery life of the portable apparatus such as the portable telephone and the like, the electric power consumption is obviously desired to be lower. However, this has a problem that the miniaturization of the motor body brings about the increases in the rotational number and the electric power consumption.

[0008]

Moreover, the assembly of the conventional vibration motor into the electronic apparatus must rely on a man power. Thus, the automation is difficult.

[0009]

Accordingly, an object of the present invention is to provide a vibration generating apparatus that can be miniaturized and thinned and automatically assembled into an electronic apparatus, and a method of manufacturing the same.

[0010]

[Means for solving the Problems]

In order to attain the above-mentioned object, a method of manufacturing a vibration generating apparatus according to the present invention described in claim 1 is characterized by including the steps of: mounting a driving electronic part and a start torque generating coil on a board; placing a magnet so as to face on the start torque generating coil in a rotor yoke, in a rotor composed of the rotor yoke and a shaft; placing an unbalance weight at a part of the rotor yoke; fixing a bearing to a bottom plate; installing a bottom plate, on which the bearing is placed, to the board; engaging the shaft with the bearing and then installing the rotor; and covering the board, the driving electronic part and the rotor with a cover, and adhering the cover to the bottom plate and then packaging.

[0011]

Also, as a preferable embodiment, for example as described in claim 2, the method of manufacturing the vibration generating apparatus described in claim 1 may be characterized in that as the driving electronic part, at least an integrated circuit composed of non-molded bare chips is mounted on the board.

[0012]

Also, as a preferable embodiment, for example as described in claim 3, the method of manufacturing the vibration generating apparatus described in claim 1 may be configured such that the board is formed with a flexible substrate, and the start torque generating coil is electrically connected to the flexible substrate through three terminals.

[0013]

Also, as a preferable embodiment, for example as described in claim 4, the method of manufacturing the vibration generating apparatus described in claim 1 may include a step of forming a terminal, which is engaged with a connector mounted on a mother board and thereby electrically connected, on a substrate protruded from the package.

[0014]

Also, as a preferable embodiment, for example as described in claim 5, the method of manufacturing the vibration generating apparatus described in claim 1 may include a step of placing a terminal, which is engaged with a socket mounted on a mother board and thereby electrically connected, on the package.

[0015]

Also, as a preferable embodiment, for example as described in claim 6, the method of manufacturing the vibration generating apparatus described in claim 1 may include a step of forming a land, which is electrically connected to a land formed on a mother board, on a surface in contact with the mother board of the package.

[0016]

In order to attain the above-mentioned object, a vibration generating apparatus according to the present invention described in claim 7 is characterized by including: a rotor yoke which is fixed to a shaft and in which an unbalance weight and a magnet are placed; a start torque generating coil that is placed on a board so as to face on the magnet; a driving electronic part placed on the board, which includes an integrated circuit composed of non-molded bare chips, supplies an alternating current to the start torque generating coil, and rotates the rotor yoke around the shaft; a bottom plate which supports the board and to which a bearing that the shaft is engaged with is fixed; and a cover, which is adhered to the bottom plate, for covering the rotor yoke, the start torque generating coil and the driving electronic part.

[0017]

Also, as a preferable embodiment, for example as described in claim 8, in the vibration generating apparatus described in claim 7, the board may be formed with a flexible substrate, and the start torque generating coil may be electrically connected to the flexible substrate through three terminals.

[0018]

Also, as a preferable embodiment, for example as described in claim 9, the vibration generating apparatus described in claim 7 may include a terminal that is formed on a substrate protruded from the package, and engaged with a connector mounted on a mother board, and thereby electrically connected.

[0019]

Also, as a preferable embodiment, for example as described in claim 10, the vibration generating apparatus described in claim 7 may include a terminal that is placed in the cover or the bottom and engaged with a socket mounted on a mother board and thereby electrically connected.

[0020]

Also, as a preferable embodiment, for example as described in claim 11, the vibration generating apparatus described in claim 7 may include a land which is formed on a surface in contact with a mother board, in the cover or the bottom, and electrically connected to a land formed on the mother board.

[0021]

In the present invention, the driving electronic part and the start torque generating coil are mounted on the board. The magnet is placed so as to face on the start torque generating coil in the rotor yoke, in the rotor composed of the rotor yoke and the shaft. The unbalance weight is placed at a part of the rotor yoke. The bearing is fixed to the bottom plate. The bottom plate on which the bearing is placed is installed to

the board. The shaft is engaged with the bearing, and the rotor is installed. Moreover, the board, the driving electronic part and the rotor are covered with the cover. Then, the cover is adhered to the bottom plate, and they are packaged. Thus, it can be miniaturized and thinned. Moreover, it can be automatically installed.

[0022]

[Mode for Carrying Out the Invention]

An embodiment of the present invention will be described below with reference to the attached drawings.

[0023]

A. Structure of Small Vibration Motor

Fig. 1 is a diagram showing the structure of a small vibration motor according to the embodiment of the present invention. An FP (Flexible Substrate) coil 1 and a magnet 2 are placed oppositely to each other. The FP coil 1 is formed with a wiring layer composed of a plurality of layers. A signal inputted through a flexible substrate 3 is converted into a three-phase voltage by a driver IC 4 so that a magnetic field is cyclically generated. The magnet 2 is linked to a yoke 6 having a shaft 5. The rotational magnetic field of the FP coil 1 rotates the magnet 2 and the yoke 6. An unbalance weight 7 is eccentrically installed to the yoke 6. The rotation of the unbalance weight 7 generates an unbalanced component to thereby generate a vibration.

[0024]

Notches 10, 10, 10, 10 are formed at the four corners of the FP coil 1, and the flexible substrate 3 is exposed. The driver IC 4, passive parts (C, R) 11 and the like are mounted on the notches 10 ... 10. The flexible substrate 3 uses polyimide as the base material, and that wiring surface is treated with Cu + Ni + Au.

[0025]

The shaft 5 is supported by a bearing 13 installed to a bottom plate 12, a thrust holder 14 and a thrust pusher 15. The bearing 13 is

made of sintered metal in which, for example, copper-based, iron-steel-based or iron-based oil is impregnated, and it is the cylindrical member. Incidentally, the bearing 13 may be made of resin.

[0026]

Also, a cover 16 is caulked and soldered and thereby fixed to the bottom plate 12. The top surface of the cover 16 is flat such that the small vibration motor can be assembled (suctioned) by a robot arm and the like when it is mounted onto the mother board. Also, a part of the flexible substrate 3 is protruded so as to be wired to the mother board. However, this protrusion is not the essential condition.

[0027]

The small vibration motor according to this embodiment as mentioned above has the approximate dimension of 8.6 × 8.6 mm and 1.9 mm (thickness), and its volume is about 140 mm^3. The conventional motor with the brush has the dimension of about 300 to 500 mm^3. Thus, the small vibration motor according to this embodiment has the volume which is substantially equal to 1/2 to 1/3.

[0028]

B. Process for Manufacturing Small Vibration Motor

The process for manufacturing the above-mentioned small vibration motor will be described below. Here, Fig. 2 is the conceptual views showing the process for manufacturing the driver IC 4. Also, Figs. 3 to 6 are the flowcharts showing the entire process for manufacturing the small vibration motor. Moreover, Figs. 7A, to 11C are the diagrammatic views explaining the process for manufacturing the small vibration motor.

[0029]

B-1. Process for Manufacturing Driver IC

At first, as shown in Fig. 2A, the necessary circuit is formed on a Si wafer by a typical process and the like. After that, as shown in Fig. 2B, a protrusion electrode is formed. Next, as shown in Fig. 2C, chips

are diced one by one, and made into pieces through an extension ring, as shown in Fig. 2D. The driver IC is not a typical package IC (an IC molded with resin and the like), and it is a so-called bare chip in which a circuit section is exposed. Also, the protrusion electrode can be formed by an Au plating, a Ni plating, an Au stud bumping method, or a solder bumping method or the like. Such a protrusion electrode can flexibly cope with the supplying condition and the inspecting method of the wafer.

[0030]

B-2. Flexible Substrate Process

On the other hand, a flexible substrate manufactured at a different step (not shown) is prepared (Step S10). At first, as shown in Fig. 7A, the driver IC (bare chip) 4 and the passive elements (C, R) 11 are placed at predetermined positions on the flexible substrate 3. Soldering (reflow) is performed thereon, and plastic components contained in paste are washed. Then, underfill resin is coated to mechanically reinforce the driver IC 4. Again, the resin is cured at a thermally curing process (Step S12). Next, as shown in Fig. 7B, the FP coil 1 manufactured at a different process is placed at a predetermined position, and soldering (reflow) is performed thereon (Step S14).

[0031]

There are three connection sections between the FP coil 1 and the flexible substrate 3, and there are only three connection terminals to the mother board (not shown) through the flexible substrate 3. Thus, although the vibrating section and the driver IC 4 are electrically connected, this is not a strong vibrator, and this has the action of attenuating the vibration generated by the flexible substrate 3 itself. Hence, it is possible to suppress the mechanical stress on the mounted portion. Then, the circuit is inspected (Step S16). If the circuit contains a repairable trouble, the operational flow returns to the step S12. It is again inspected by again carrying out the soldering and the like.

On the other hand, if it contains a trouble that can not be repaired, it is discarded (Step S18). Also, if the inspected result is OK, the operational flow proceeds to a next process, which will be described later.

[0032]

B-3. Process for Installing Bearing

On the other hand, a bottom plate to package the small vibration motor is prepared (Step S20). The bottom plate 12 is manufactured by performing a rolling process on an aluminum plate and the like. At first, as shown in Fig. 8A, the bearing 13 is installed onto the bottom plate 12 (Step S22). Then, as shown in Figs. 8B, 8C, the thrust holder 14 and the thrust pusher 15 are installed (Step S24) and calked and thereby fixed (Step S26). Next, whether or not the bearing 13, the thrust holder 14 and the thrust pusher 15 are normally installed is inspected (Step S28). Here, if any of them has a defect, it is discarded (Step S30). On the other hand, if they have no defect, the operational flow proceeds to a next process which will be described later.

[0033]

B-4. Rotor Yoke Process

On the other hand, the rotor yoke 6 is prepared (Step S40). As shown in Fig. 9A, the magnet 2 is adhered (Step S42). Then, the magnet 2 is magnetized (Step S44). As shown in Fig. 9B, the shaft 5 is forced (Step S46). Then, as shown in Fig. 9C, the unbalance weight 7 is adhered/calked and thereby fixed (Step S48).

[0034]

B-5. Assembling Process

Next, as shown in Figs. 10A, 10B, the flexible substrate 3 formed by the above-mentioned flexible substrate process, on which the parts are mounted, is adhered on the bottom plate 12 manufactured by the process for installing the bearing as mentioned above. (Step S50). Next, as shown Fig. 10B, the shaft 5 and the rotor yoke 6 manufactured by the

above-mentioned rotor yoke process are installed to the bearing 13 (Step S52). Next, as shown in Fig. 10C, the differently manufactured cover 16 is calked and thereby fixed to the bottom 12 (Step S54), and a terminal to be electrically connected to the mother board is soldered to the protrusion section of the flexible substrate 3 (Step S56). Then, the appearance test and the electrical inspection are done (Step S58). If there is a defect, it is discarded (Step S60). On the other hand, there is no defect, it is shipped (Step S62). The small vibration motor 30 is completed as mentioned above.

[0035]

The small vibration motor 30 according to the above-mentioned embodiment can be miniaturized and thinned. As compared with conventional motor with the brush, the longitudinal and lateral dimension is about 8.6 × 8.6 mm, and its thickness is about 1.9 mm, and its volume is about 140 mm^3. Thus, this has the volume substantially equal to 1/2 to 1/3. Also, the driver IC can be mounted in the condition of the bare chip. Hence, this has the effects that the chip manufacturing processes may be reduced and that the rotation of the rotor yoke 6 inside it makes the cooling efficiency higher.

[0036]

Also, since a driver IC 14 is built in, the mounting on the mother board (not shown) can be treated similarly to the surface mount part. At this time, the mounted direction of the small vibration motor 30 needs to be identified. However, with regard to this identification, a simple mark 31 may be printed as shown in Figs. 11A to 11C, or a part of the outer surface may be cut away so as to function as a notch 32, as shown in Fig. 11D.

[0037]

By the way, as the method of mounting the small vibration motor 30 on the mother board, there are: a manner of using an FPC (Flexible Printed Circuit Board) connector 40 electrically connected to the

terminal formed on the protrusion section of the flexible substrate 3, as shown in Fig. 12A; a manner of using a socket 41 that is engaged with and electrically connected to a terminal placed in a package, as shown in Fig. 12B; and a manner of forming lands 42 on the rear surface of the small vibration motor 30 and then mounting on the mother board similarly to the surface mount part. In this way, it is possible to flexibly cope with a request from a client.

[0038]

Also, as a manner of a part shipment/delivery, a reel-shaped tape 50 can be used to pack, as shown in Fig. 13. Thus, the part management can be made easier. The small vibration motor 30 is stored in a small vibration motor storing unit 51 of the reel-shaped tape 50 in which reel wheel holes 52 are formed.

[0039]

[Effect of the Invention]

According to the present invention described in claim 1, it is configured to include: mounting a driving electronic part and a start torque generating coil on a board; placing a magnet so as to face on said start torque generating coil in a rotor yoke, in a rotor composed of said rotor yoke and a shaft; placing an unbalance weight at a part of said rotor yoke; fixing a bearing to a bottom plate; installing a bottom plate, on which said bearing is placed, to said board; engaging said shaft with said bearing and then installing said rotor; and covering said board, said driving electronic part and said rotor with a cover, and adhering said cover to said bottom plate and then packaging. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0040]

Also, according to the present invention described in claim 2, it is configured such that, as the driving electronic part, at least an integrated circuit composed of non-molded bare chips is mounted on the

board. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0041]

Also, according to the present invention described in claim 3, it is configured such that the board is formed with a flexible substrate, and the start torque generating coil is electrically connected to the flexible substrate through three terminals. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0042]

Also, according to the present invention described in claim 4, it is configured to form a terminal, which is engaged with a connector mounted on a mother board and thereby electrically connected, on a substrate protruded from the package. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0043]

Also, according to the present invention described in claim 5, it is configured to place a terminal, which is engaged with a socket mounted on a mother board and thereby electrically connected, on the package. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0044]

Also, according to the present invention described in claim 6, it is configured to form a land, which is electrically connected to a land formed on a mother board, on a surface in contact with the mother board of the package. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0045]

Also, according to the present invention described in claim 7, it is configured to include: a rotor yoke which is fixed to a shaft and in

which an unbalance weight and a magnet are placed; a start torque generating coil that is placed on a board so as to face on the magnet; a driving electronic part placed on the board, which includes an integrated circuit composed of non-molded bare chips, supplies an alternating current to the start torque generating coil, and rotates the rotor yoke around the shaft; a bottom plate which supports the board and to which a bearing that the shaft is engaged with is fixed; and a cover, which is adhered to the bottom plate, for covering the rotor yoke, the start torque generating coil and the driving electronic part. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0046]

Also, according to the present invention described in claim 8, it is configured such that the board is formed with a flexible substrate, and the start torque generating coil is electrically connected to the flexible substrate through three terminals. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0047]

Also, according to the present invention described in claim 9, it is configured to include a terminal that is formed on a substrate protruded from the package, and engaged with a connector mounted on a mother board, and thereby electrically connected. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[0048]

Also, according to the present invention described in claim 10, it is configured to include a terminal that is placed in the cover or the bottom and engaged with a socket mounted on a mother board and thereby electrically connected. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic

devices.

[0049]

Also, according to the present invention described in claim 10, it is configured to include a land which is formed on a surface in contact with a mother board, in the cover or the bottom, and electrically connected to a land formed on the mother board. Thus, it has an advantage in that it can be miniaturized and thinned, and automatically installed to electronic devices.

[Brief Description of the Drawings]

[Fig. 1]

It is a diagram showing a structure of a small vibration motor according to an embodiment of the present invention.

[Fig. 2]

It is a conceptual view showing a process for manufacturing a driver IC 4.

[Fig. 3]

It is a flowchart showing the whole process for manufacturing a small vibration motor.

[Fig. 4]

It is a flowchart showing the whole process for manufacturing a small vibration motor.

[Fig. 5]

It is a flowchart showing the whole process for manufacturing a small vibration motor.

[Fig. 6]

It is a flowchart showing the whole process for manufacturing a small vibration motor.

[Fig. 7]

It is a diagram explaining a process for manufacturing a small vibration motor.

[Fig. 8]

It is a diagram explaining a process for manufacturing a small vibration motor.

[Fig. 9]

It is a diagram explaining a process for manufacturing a small vibration motor.

[Fig. 10]

It is a diagram explaining a process for manufacturing a small vibration motor.

[Fig. 11]

It is a diagram explaining a process for manufacturing a small vibration motor.

[Fig. 12]

It is a diagram showing an example of a method of mounting a small vibration motor 30 onto a mother board.

[Fig. 13]

It is a diagram showing an example of a part shipping/delivering manner of the small vibration motor 30.

[Fig. 14]

It is a diagram showing the inner structure of a portable telephone in which a vibration motor serving as a conventional vibration actuator is built.

[Description of Reference Numerals]

1...FP COIL (START TORQUE GENERATING COIL)

2...MAGNET

3...FLEXIBLE SUBSTRATE (SUBSTRATE)

4...DRIVER IC (DRIVING ELECTRONIC PART)

5...SHAFT

6...YOKE

7...UNBALANCE WEIGHT

10...NOTCH

11... PASSIVE PART (DRIVING ELECTRONIC PART)

12... BOTTOM PLATE

13... BEARING

14... THRUST HOLDER

15... THRUST PUSHER

16... COVER

[English Translation for Drawings]

[FIG. 3]

S10: FLEXIBLE SUBSTRATE

S12: SOLDER A

S14: SOLDER B

S16: INSPECT

S18: DISCARD

ドライブ IC: DRIVE IC

フレキシブルコイル: FLEXIBLE COIL

[FIG.4]

S20: BOTTOM PLATE

S22: INSTALL

S24: INSTALL

S26: CALK

S28: INSPECT

S30: DISCARD

軸受け: BEARING

スラスト受け: THRUST HOLDER

スラスト押さえ: THRUST PUSHER

[FIG. 5]

S40: ROTOR YOKE

S42: INSTALL

S44: MAGNETIZE

S46: FORCE

S48: ADHERE/CALK

マグネット: MAGNET

シャフト: SHAFT

アンバランス錘: UNBALANCE WEIGHT

[FIG. 6]

S50: ADHERE

S52: INSTALL

S54: CALK

S56: SOLDER

S58: INSPECT

S60: DISCARD

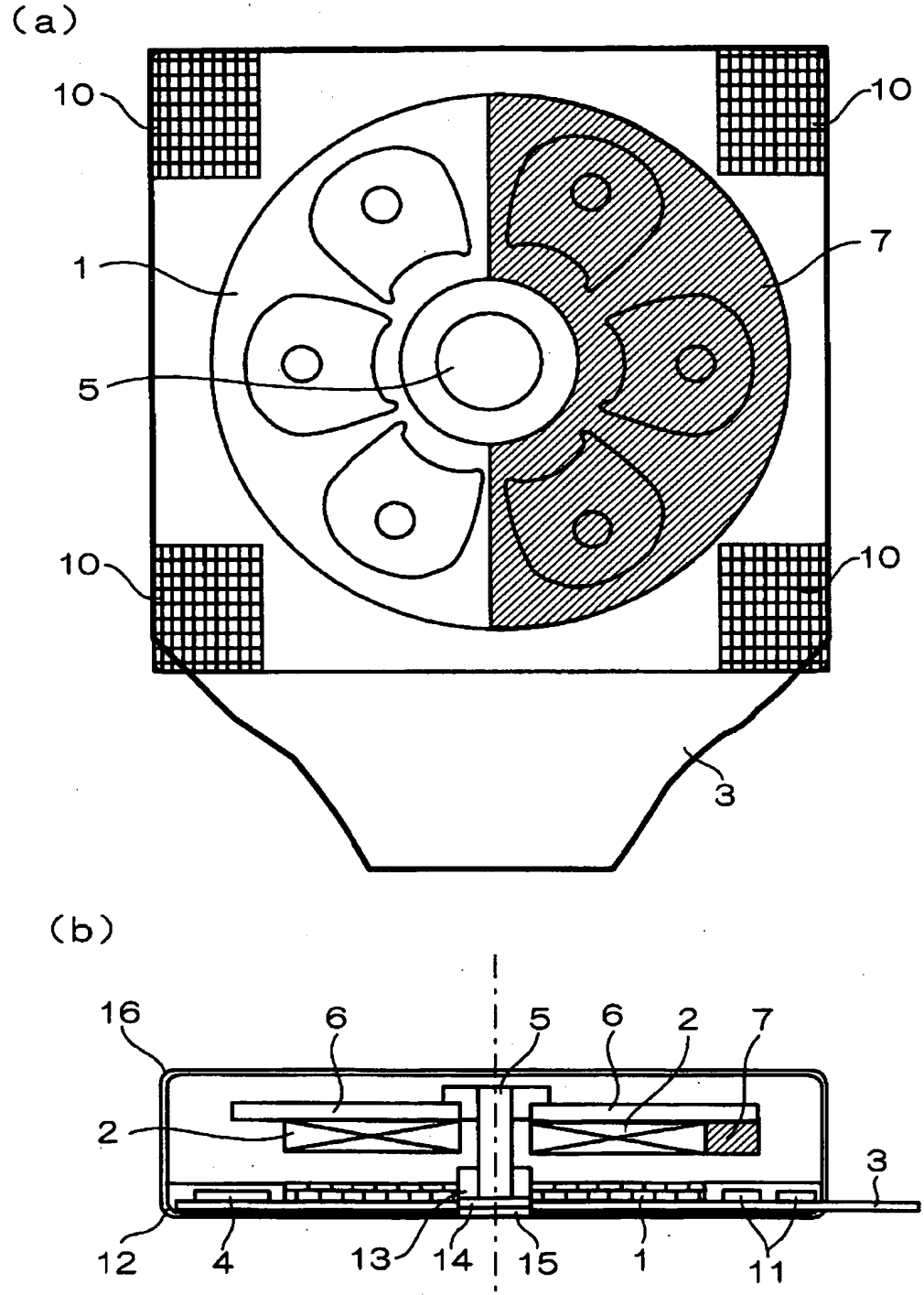
S62: SHIP

蓋部: COVER

端子: TERMINAL

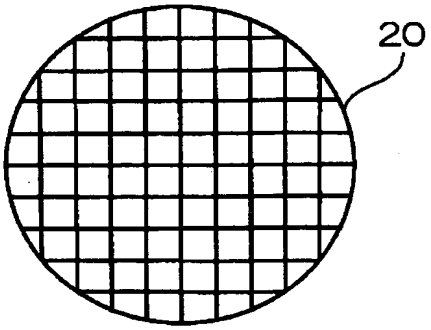
【書類名】　図面

【図１】



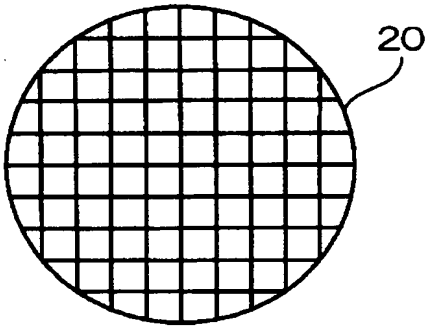
【図２】

（a）

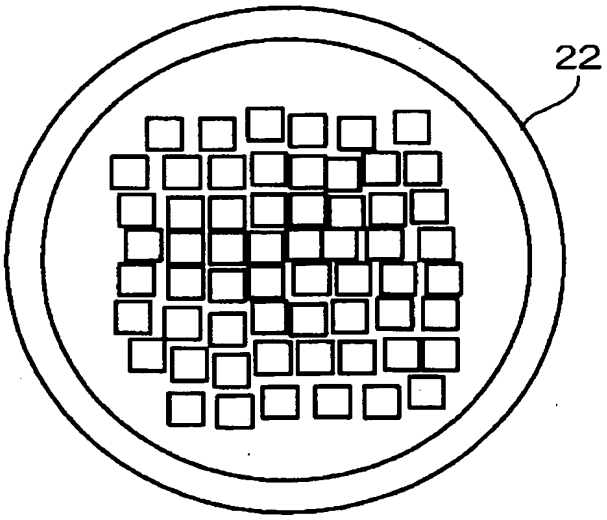


（b）

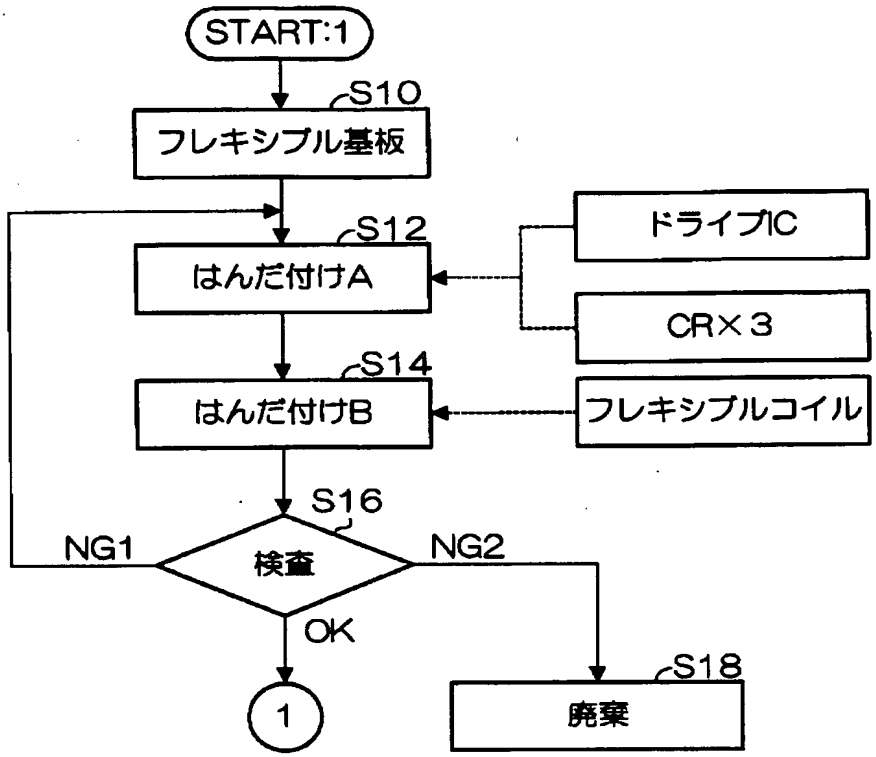
（c）



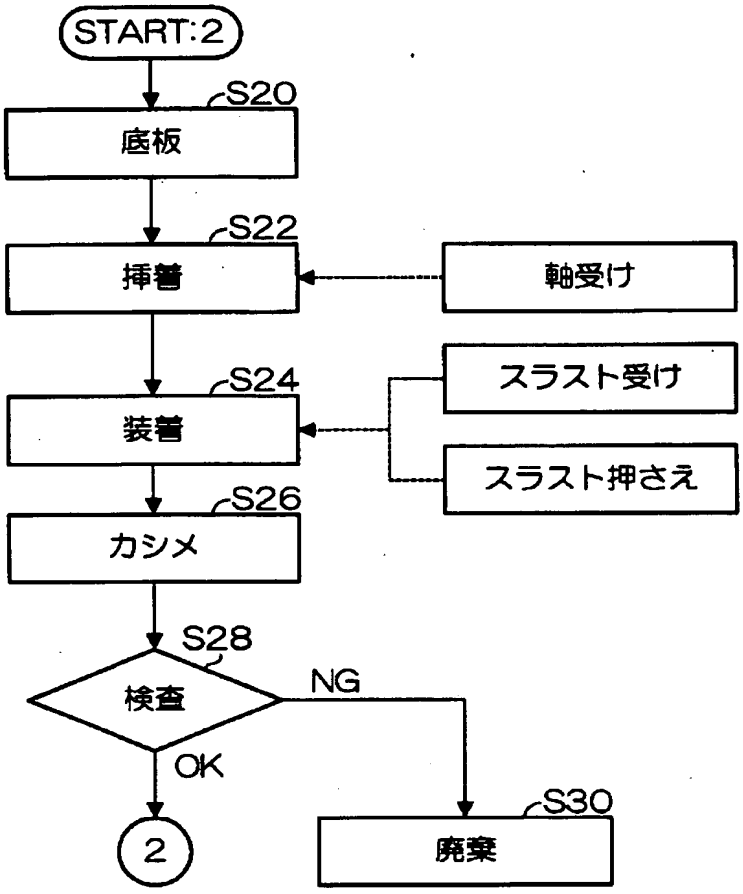
（d）



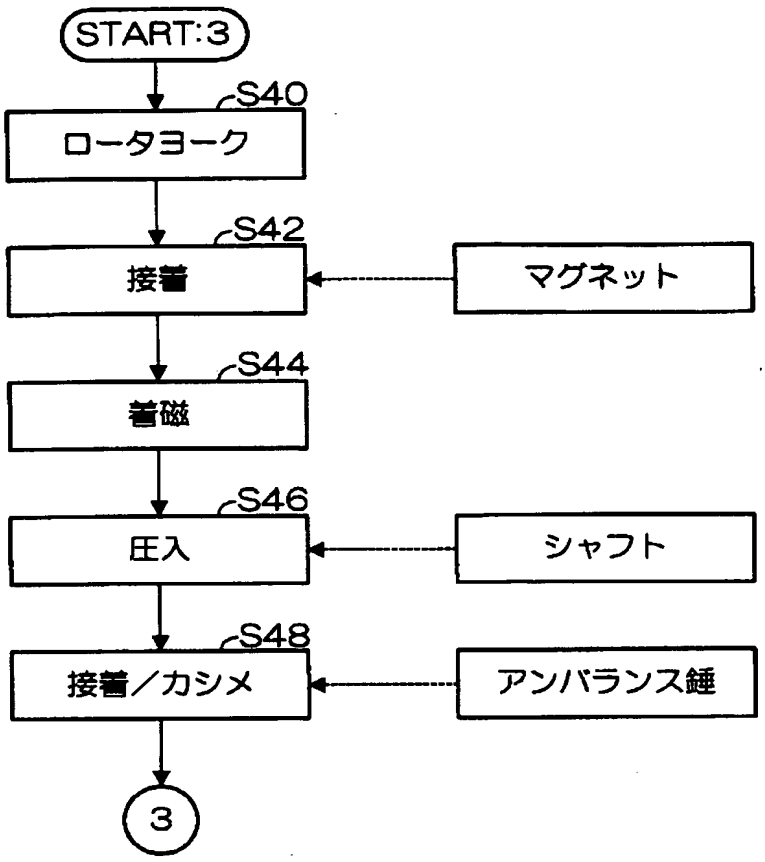
【図３】


START:1
S10
フレキシブル基板
S12
はんだ付けA
ドライブIC
CR×３
S14
はんだ付けB
フレキシブルコイル
S16
NG1
検査
NG2
OK
1
S18
廃棄

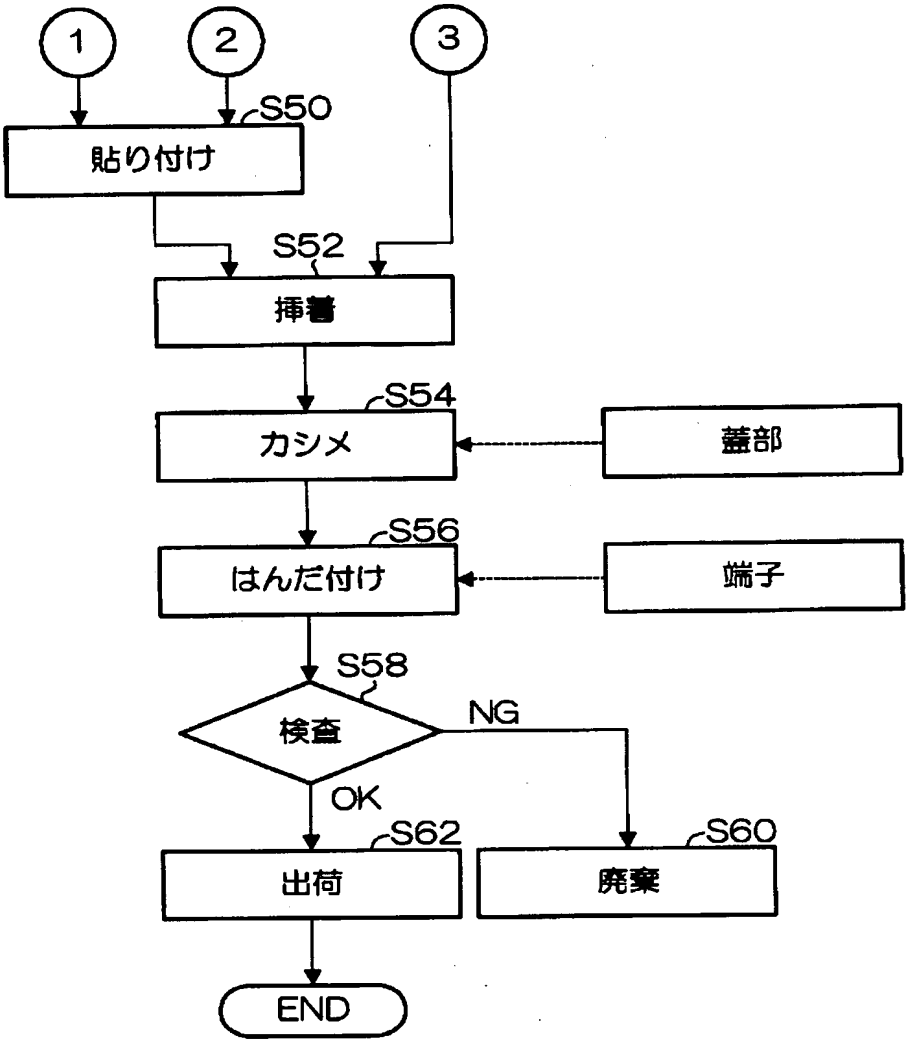
【図４】


START:2
S20
底板
S22
挿着
軸受け
S24
装着
スラスト受け
スラスト押さえ
S26
カシメ
S28
検査
NG
OK
2
S30
廃棄

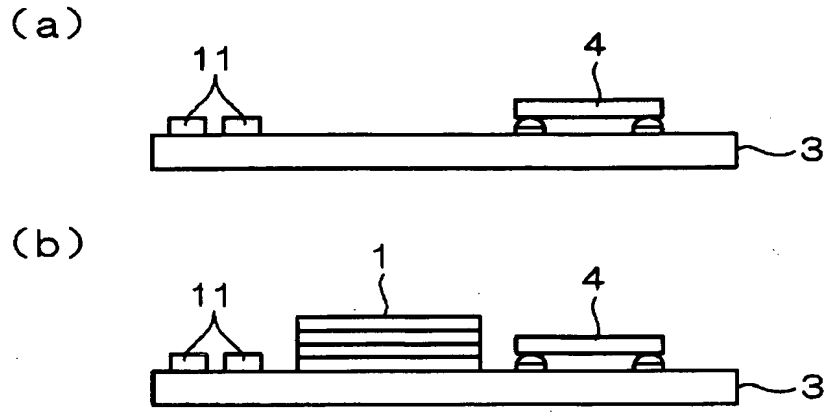
【図５】


START:3
S40
ロータヨーク
S42
接着
マグネット
S44
着磁
S46
圧入
シャフト
S48
接着／カシメ
アンバランス錘
3

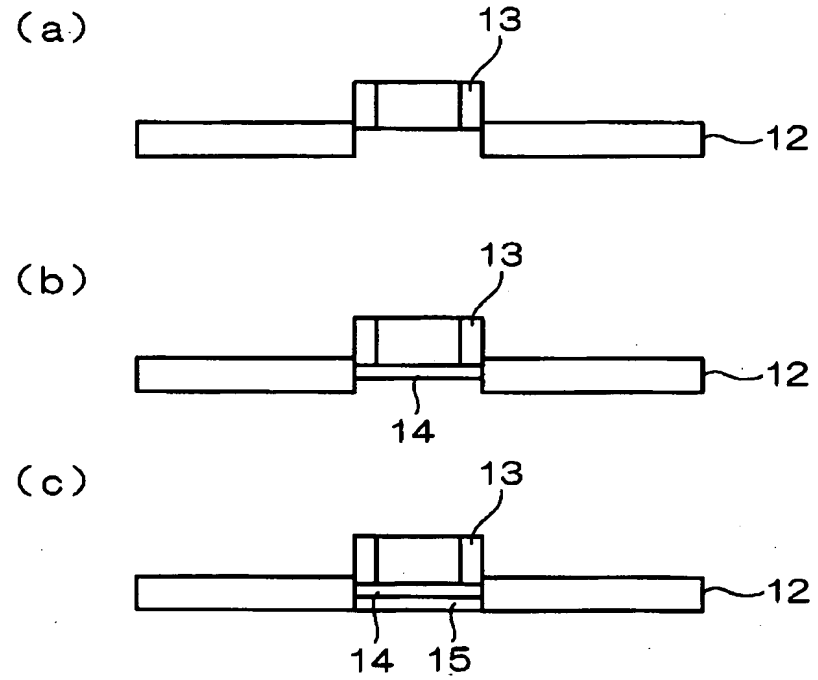
【図６】


1
2
3
S50
貼り付け
S52
挿着
S54
カシメ
蓋部
S56
はんだ付け
端子
S58
検査
NG
OK
S62
出荷
S60
廃棄
END

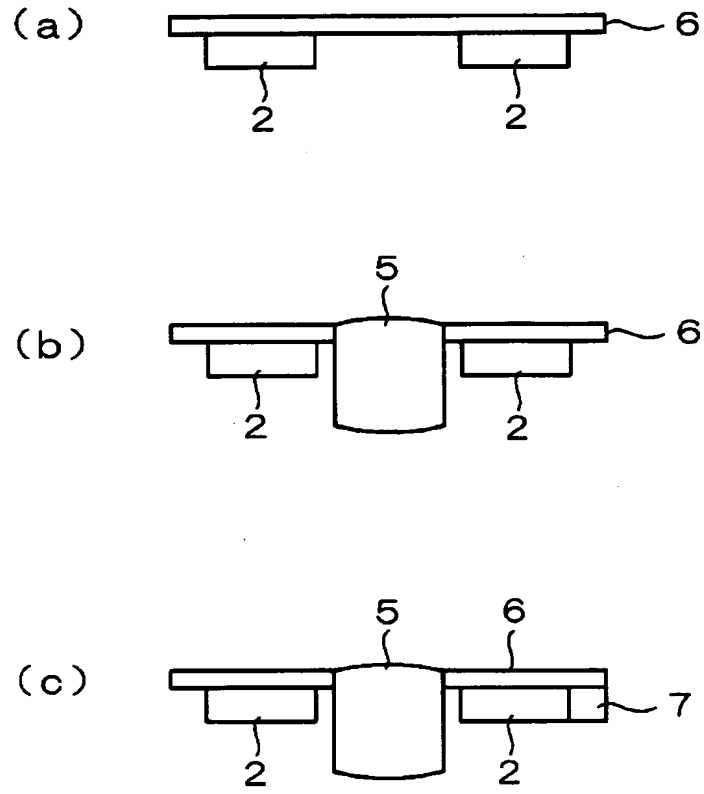
【図７】



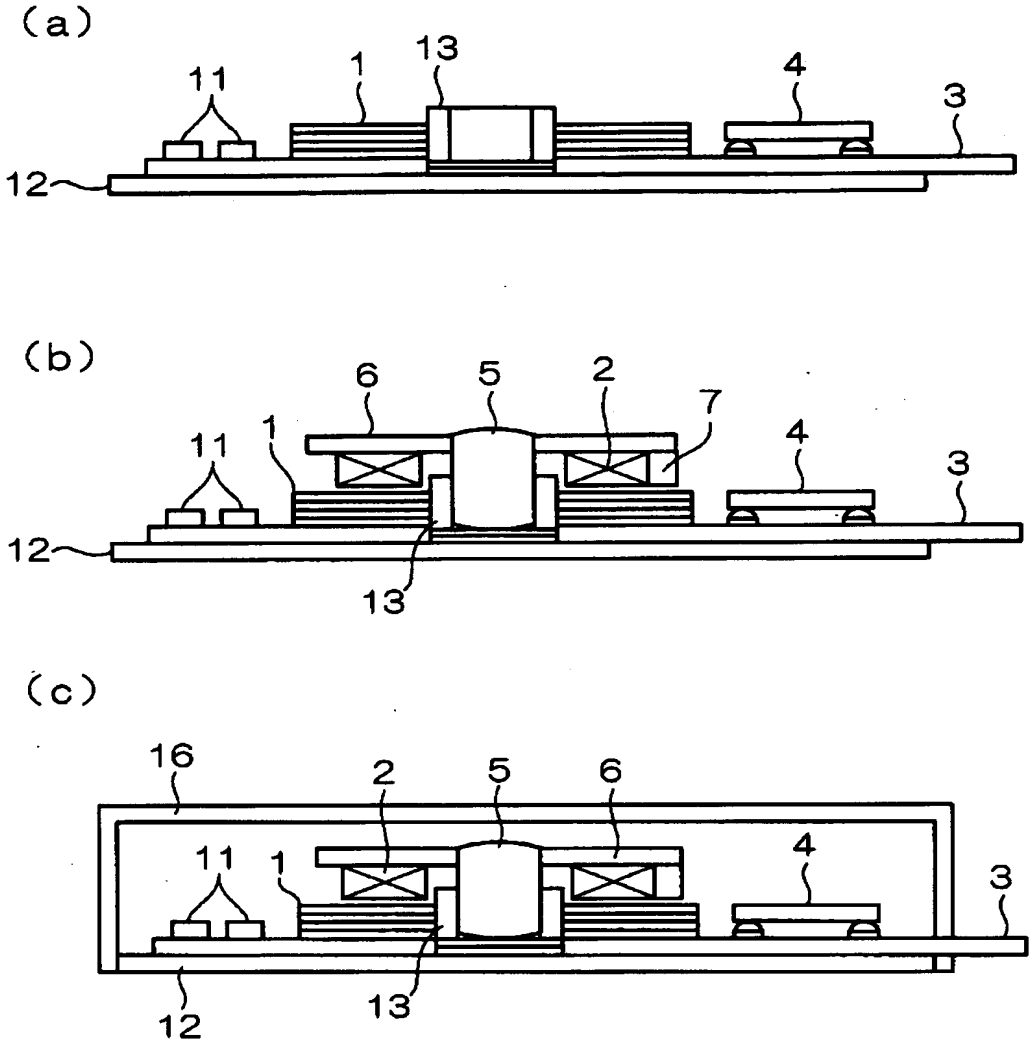
【図８】



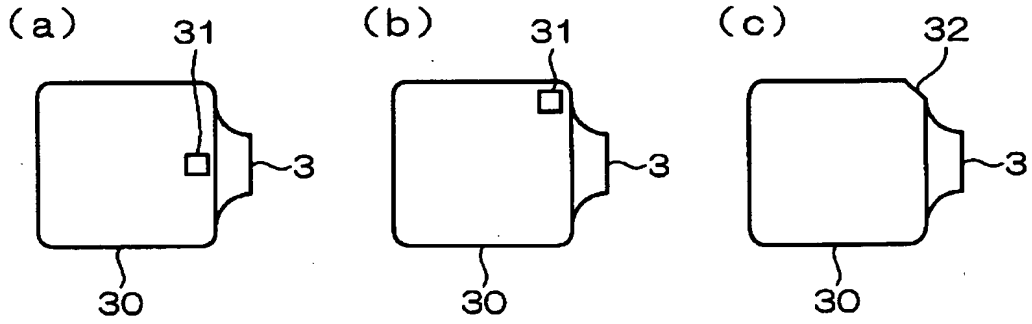
【図９】



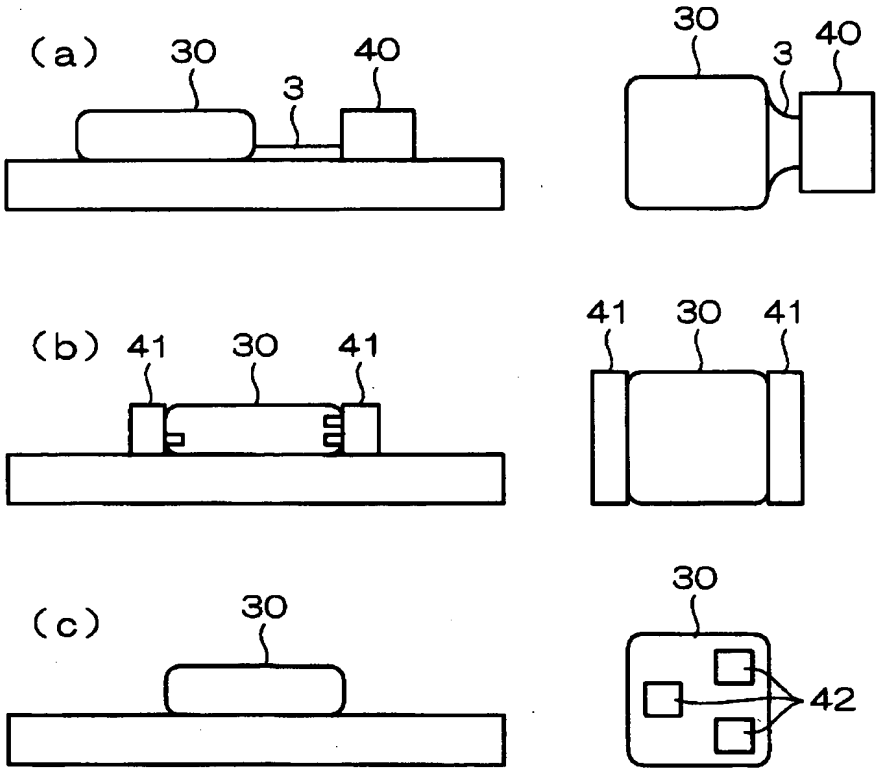
【図１０】



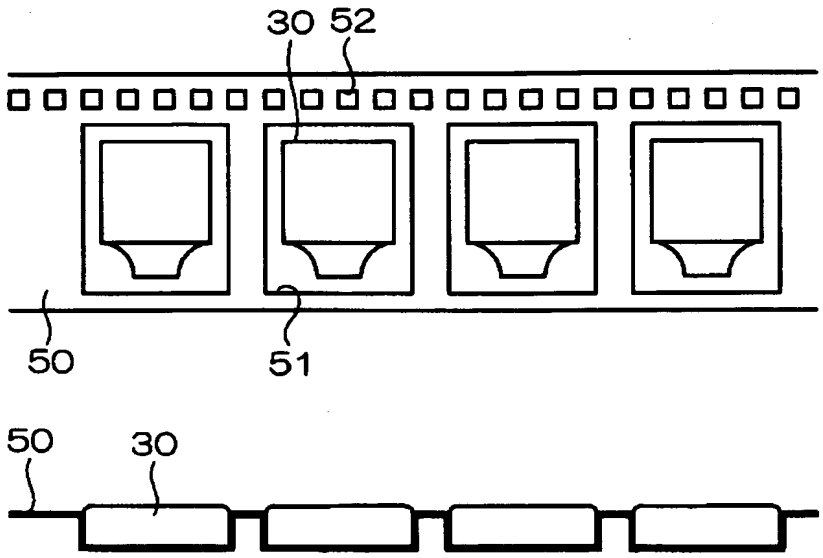
【図１１】



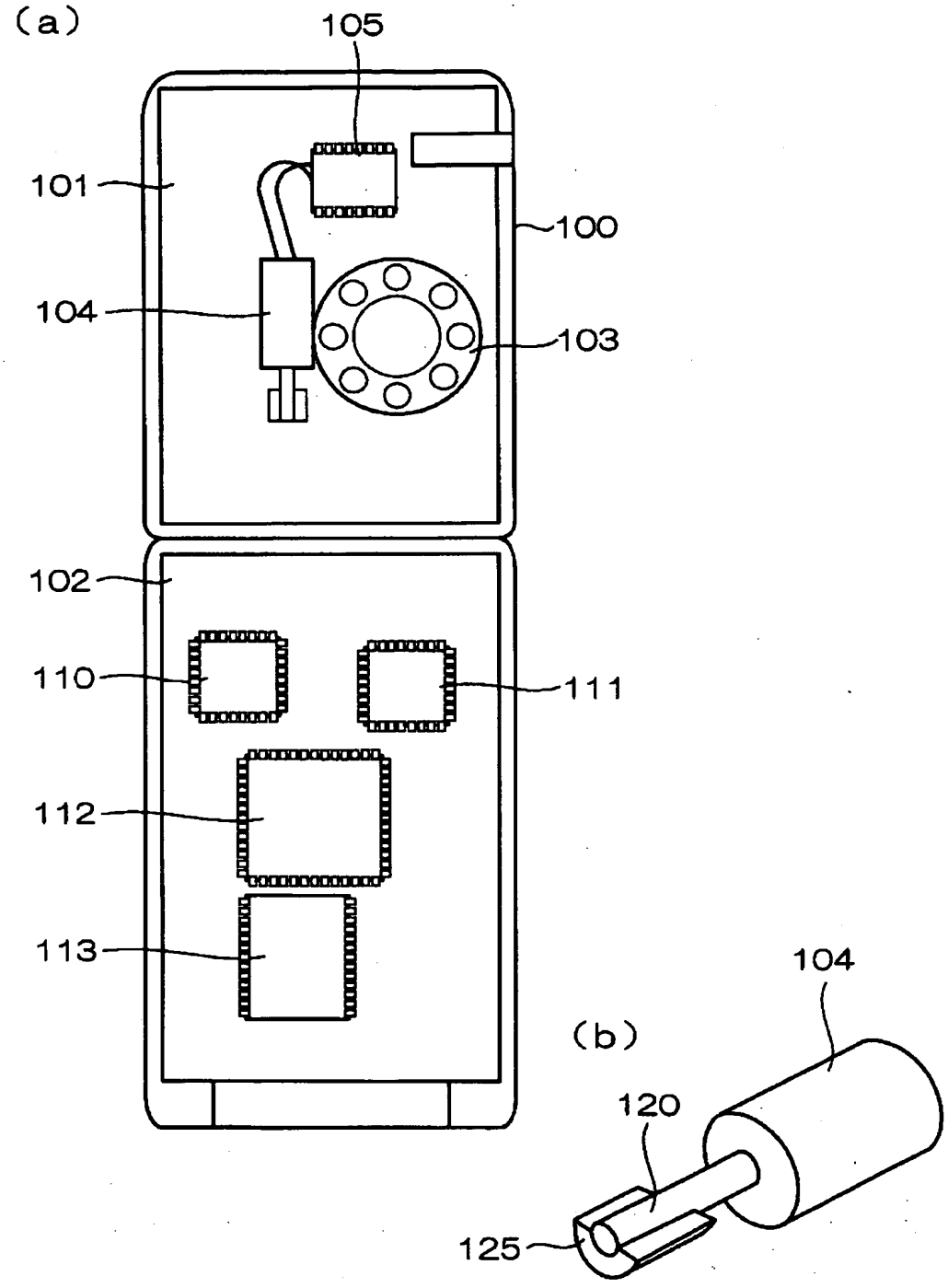
【図１２】



【図１３】



【図１４】



[Name of the Document] Abstract of the Disclosure

[Abstract]

[Problem] Enabling miniaturization and thinning; and automatic installation to an electronic apparatus.

[Solving Means] A driver IC 4 which convert a direct current voltage into a three-phase voltage, passive parts 11, and an FP coil 1 for cyclically generating a magnetic field through the driver IC 4 are mounted on a flexible substrate 3. The driver IC is a so-called bare chip whose circuit section is exposed and is not molded with resin or the like. A magnet 2 and an unbalance weight 7 are installed on a yoke 6 having a shaft 5. The FP coil 1 and the magnet 2 are placed so as to face each other. A cover 16 is caulked to fixed to a bottom plate 12.

[Selected Figure] Fig. 1